Claims

[c1] 1.A magnetic trip unit for actuating a latching mechanism to trip a circuit breaker upon an overcurrent condition, the magnetic trip unit including:
a first electrically conductive strap configured to conduct an electrical current;
a first magnet yoke disposed proximate to said first electrically conductive strap; and
a first armature pivotally disposed proximate to said first magnetic yoke in operable communication with the latching mechanism; said first armature providing a magnetic path having a reluctance to magnetic flux; said reluctance is adjusted to prevent saturation of said magnetic flux when said current through said strap is a first number times a rated current of the circuit breaker and said reluctance is adjusted to promote saturation of said magnetic flux when said current through said strap is a second number times said rated current of the circuit breaker; wherein said first number is a number smaller than said second number.

[c2] 2.The magnetic trip unit of claim 1, wherein said reluctance is adjusted by setting a length of said magnetic path to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said length generally saturates with said magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c3] 3.The magnetic trip unit of claim 1, wherein said reluctance is adjusted by selecting a material having a permeability to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said permeability promotes saturation of said magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c4] 4.The magnetic trip unit of claim 1, wherein said reluctance includes a cross sectional area of said magnetic path to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said cross sectional area generally saturates with said

magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c5] 5.The magnetic trip unit of claim 4, wherein said cross sectional area includes by removing an amount of material from said armature.

[c6] 6. The magnetic trip unit of claim 1, wherein said reluctance allows a flux density below a saturation flux density at said first number times said rated current.

[c7] 7.The magnetic trip unit of claim 1, wherein said reluctance allows increases in said magnetic flux across said magnetic path without saturating when said current through said strap is said first number times said rated current and said magnetic flux approaches saturation as said current through said strap increases towards said second number times said rated current.

[c8] 8. The magnetic trip unit of claim 4, wherein said cross section area accounts for an aperture for receiving a bias.

[c9] 9.The magnetic trip unit of claim 1, wherein said first magnetic yoke includes a metal plate comprising a U-shaped bight.

[c10] 10.The magnetic trip unit of claim 9, wherein said U-shaped bight includes a pair of flanges extending from opposite ends of said U-shaped bight and a gap between said flanges; said gap being spaced for maximum flux egress from side edges of said flanges to said first armature; said flanges being arranged to generate a magnetic flux within said plate in response to said current through said first electrically conductive strap.

[c11] 11.The magnetic trip unit of claim 10, wherein said gap is larger than a first distance separating said first armature and said first magnet yoke; said first distance provides less said reluctance for said magnetic flux than said gap.

[c12] 12.The magnetic trip unit of claim 11, wherein said first armature is positioned at said first distance from said magnet yoke when the circuit breaker trips at said X times said rated current.

[c13] 13.The magnetic trip unit of claim 10, wherein said gap is smaller than a second distance separating said first armature and said first magnet yoke; said second distance provides more said reluctance for said magnetic flux than said gap.

[c14] 14.The magnetic trip unit of claim 13, wherein said armature is positioned at said second distance from said magnet yoke when the circuit breaker trips at said Y times said rated current.

[c15] 15. The magnetic trip unit of claim 1, wherein said armature is attached to said first electrically conductive strap.

[c16] 16.The magnetic trip unit of claim 1, wherein said first armature comprises of steel; said cross beam having a saturation flux density of about 2 teslas (T).

[c17] 17.The magnetic trip unit of claim 1, wherein said first armature includes a clip disposed on a free end of said armature, said clip adapted for operable contact with an adjusting screw.

[c18] 18.A circuit breaker including:

a first contact arm arranged between first and second electrically conductive straps;

a latching mechanism configured to move said first contact arm out of contact with said first and second electrically conductive straps;

a first magnet yoke disposed proximate to said first electrically conductive strap; and

a first armature pivotally disposed proximate to said first magnetic yoke in operable communication with the latching mechanism; said first armature providing a magnetic path having a reluctance to magnetic flux; said reluctance is adjusted to prevent saturation of said magnetic flux when said current through said strap is a first number times a rated current of the circuit breaker and said reluctance is adjusted to promote saturation of said magnetic flux when said current through said strap is a second number times said rated current of the circuit breaker; wherein said first number is a number smaller than said second number.

[c19] 19.The circuit breaker of claim 18, wherein said reluctance is adjusted by

setting a length of said magnetic path to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said length generally saturates with said magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c20] 20.The circuit breaker of claim 18, wherein said reluctance is adjusted by selecting a material having a permeability to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said permeability promotes saturation of said magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c21] 21.The circuit breaker of claim 18, wherein said reluctance includes a cross sectional area of said magnetic path to prevent saturation of said magnetic flux when said current through said strap is said first number times a rated current of the circuit breaker and said cross sectional area generally saturates with said magnetic flux when said current through said strap is said second number times said rated current of the circuit breaker.

[c22] 22.The circuit breaker of claim 21, wherein said cross sectional area includes by removing an amount of material from said armature.

[c23] 23. The circuit breaker of claim 18, wherein said reluctance allows a flux density below a saturation flux density at said first number times said rated current.

[c24] 24.The circuit breaker of claim 18, wherein said reluctance allows increases in said magnetic flux across said magnetic path without saturating when said current through said strap is said first number times said rated current and said magnetic flux approaches saturation as said current through said strap increases towards said second number times said rated current.

[c25] 25. The circuit breaker of claim 21, wherein said cross section area accounts for an aperture for receiving a bias.

[c26] 26.The circuit breaker of claim 18, wherein said first magnetic yoke includes a

metal plate comprising a U-shaped bight.

[c27] 27.The circuit breaker of claim 26, wherein said U-shaped bight includes a pair of flanges extending from opposite ends of said U-shaped bight and a gap between said flanges; said gap being spaced for maximum flux egress from side edges of said flanges to said first armature; said flanges being arranged to generate a magnetic flux within said plate in response to said current through said first electrically conductive strap.

[c28] 28.The circuit breaker of claim 27, wherein said gap is larger than a first distance separating said first armature and said first magnet yoke; said first distance provides less said reluctance for said magnetic flux than said gap.

[c29] 29.The circuit breaker of claim 28, wherein said first armature is positioned at said first distance from said magnet yoke when the circuit breaker trips at said X times said rated current.

[c30] 30.The circuit breaker of claim 27, wherein said gap is smaller than a second distance separating said first armature and said first magnet yoke; said second distance provides more said reluctance for said magnetic flux than said gap.

[c31] 31.The circuit breaker of claim 30, wherein said armature is positioned at said second distance from said magnet yoke when the circuit breaker trips at said Y times said rated current.

[c32] 32. The circuit breaker of claim 18, wherein said armature is attached to said first electrically conductive strap.

[c33] 33.The circuit breaker of claim 18, wherein said first armature comprises of steel; said cross beam having a saturation flux density of about 2 teslas (T).

[c34] 34.The circuit breaker of claim 18, wherein said first armature includes a clip disposed on a free end of said armature, said clip adapted for operable contact with an adjusting screw.

[c35] 35.A method of increasing an induced magnetic force from a magnet yoke on a pivotally mounted armature of a trip unit in a circuit breaker at a low current

without substantially altering the induced magnetic force acting on the armature at a high current, the method comprising:

configuring the armature to provide a magnetic path having a reluctance to a magnetic flux; and

adjusting said reluctance of said magnetic path to prevent saturation of said magnetic flux when a current through the trip unit is a first number times a rated current of the circuit breaker, and said magnetic path is generally saturated when said current through the circuit breaker is a second number times said rated current, wherein said first number is a number smaller than said second number.

[c36] 36.The method of claim 35, wherein said adjusting said reluctance of said magnetic path includes adjusting a cross sectional area of said magnetic path.

[c37] 37.The method of claim 35 further comprising:

configuring the magnetic yoke having a metal plate with side arms generally extending perpendicularly therefrom comprising a U-shaped bight, wherein said side arms include a pair of flanges extending from opposite ends of said U-shaped bight and a gap between said flanges;

configuring said gap larger than a first distance separating the armature and the magnet yoke; said first distance providing less said reluctance for said magnetic flux than said gap, thus allowing flux to gather between said first distance providing substantial magnetic attraction of the armature towards the magnetic yoke; and

positioning the armature at said first distance from said magnet yoke for setting the circuit breaker to trip at said first number times said rated current.

[c38] 38. The method of claim 35 further comprising:

configuring said gap smaller than a second distance separating the armature and the magnet yoke; said second distance providing more said reluctance to said magnetic flux than said gap, thus allowing flux to gather between said gap rather than said second distance; and

positioning the armature at said second distance from the magnet yoke for setting the circuit breaker to trip at said second number times said rated

current.